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Our anesthesia experience in patients with aortic pathologies who underwent endovascular treatment

Anesthesia aortic pathologies endovascular treatment

Buket Ozyaprak[1], Canan Yılmaz[2], Ümran Karaca[3], Filiz Ata[4], Yusuf Ata[5], Mehmet Gamlı[6], Nail Kahraman[7], Şermin Eminoğlu[8], Şeyda Özgünay[9], Gönül Erkan[10], Ahmet Eroğlu[11]

[1,2,3,4,6,8,9]Department of Anesthesiology and Reanimation, Bursa Yüksek Ihtisas Training and Research Hospital, Health Sciences University,
[5,7] Department of Cardiovasculary Surgery, Bursa Yüksek Ihtisas Training and Research Hospital, Health Sciences University, Bursa,
[10] Department of Anesthesiology and Reanimation, Ahi Evren Training and Research Hospital, Health Sciences University, Trabzon,
[11] Department of Anesthesiology and Reanimation, Karadeniz Technical University, Trabzon, Turkey.

Abstract

Aim: The aim of this study was to investigate the demographic characteristics, comorbidity factors and intraoperative and postoperative data of patients over 18 years of age who underwent endovascular aortic repair (EVAR) and thoracic endovascular aortic repair (TEVAR) due to aortic pathologies and to compare them with the literature.

Materials and Methods: In this study, 52 patients who underwent endovascular repair for aortic pathology in Bursa Yüksek İhtisas Hospital between January 2015 and May 2017 were evaluated retrospectively.

Results: It was found that 40 patients underwent EVAR and 12 patients underwent TEVAR. The mean ages of patients who underwent EVAR and TEVAR were 71.6 ± 7.26 years and 59.75 ± 15.29 years, respectively. Male gender was statistically significantly dominant among all patient groups ($p < 0.05$). The most frequent comorbidity was hypertension in both groups. The most preferred method for anesthesia was local anesthesia administered together with sedoanalgesia (71.43%). Bleeding was the most common complication. Mortality rate was 7.14% among all patients.

Discussion: The results of patients who underwent endovascular repair for aortic pathologies may vary among different centers according to the number of patients involved and surgical experience. Our results are consistent with those in the literature.

Keywords

Aorta; Endovascular; EVAR; TEVAR

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Corresponding Author: Buket Ozyaprak, Department of Anesthesiology and Reanimation, Bursa Yüksek Ihtisas Training and Research Hospital, Health Sciences University, Bursa,Turkey.
E-mail: ozyaprakertugrul@gmail.com
Corresponding Author ORCID ID: https://orcid.org/0000-0002-6327-4573

Introduction

The frequency of diagnosis of aortic diseases has escalated due to technological advances, an increase in the elderly population, and easy access to health services. In their study involving aortic aneurysm patients conducted across 21 countries, Sampson et al. have reported that mortality rates have increased to 2.78/100000 from 2.49/100000 between 1990-2010. This is due to the upsurge in the frequency of diagnosis [1].

Despite advances in imaging methods and modern treatment protocols, aortic pathologies are highly serious cases in which early diagnosis remains important. The high postoperative mortality in open surgical methods, especially in risky patient groups, necessitated the search for new methods. Endovascular repair therapies, which emerged as a result of the search for new methods, first began to become widespread in the 1990s. While EVAR and TEVARwere primarily performed in risky patients, advances in stent graft technology have led to a broader range of indications [2,3].

It has been reported that the use of blood products and medium- and long-term mortality rates are lower, and operation times, stays in the intensive care unit and hospitalization durations are shorter in endovascular repair performed for aortic pathologies [4,5].

In endovascular repair treatment, anesthesia management plays a vital role in reducing patient risk and increasing the comfort of the procedure. The used anesthesia methods range from general and regional anesthesia to sedoanalgesia and local anesthesia [5].

In this study, we aimed to examine the patients who received anesthesia during endovascular treatment of aortic pathologies in our clinic and contribute to the literature by discussing our results.

Material and Methods

The study was begun after the approval of the ethics committee was obtained according to the Helsinki Declaration. The study population consisted of patients over 18 years of age who received anesthesia during endovascular repair for aortic pathology in our hospital between January 2015 and May 2017. The data required for the study were retrospectively obtained from patient files and hospital information system. Demographic data and comorbid factors were recorded. American Society of Anesthesiologists (ASA) scores, ejection fraction, location and type of aortic pathology, procedure, anesthesia method, duration of anesthesia and procedure, hemodynamic findings, intensive care unit and hospital stays, complications and mortality were also noted. The criteria for inclusion in the study were defined as patients of 18 years or older who underwent endovascular treatment for aortic pathologies with general anesthesia, regional anesthesia or sedoanalgesia with local anesthesia. Exclusion criteria included patients younger than 18 years and patients who developed cardiac arrest before the procedure.

Routine Surgical Procedure

Patients' anamnesis, physical examination, biochemical and radiological examinations were evaluated, and the decision was made for endovascular repair. The procedure was performed in patients with high expected peroperative morbidity and mortality for open surgery and whose aortic anatomies were suitable for endovascular repair. EVAR and TEVAR patients were informed about the procedure and that they could be treated with open surgery if necessary. Informed consent was obtained from all patients. Anesthesia consultation was requested for preoperative evaluation.

Routine Anesthesia Procedure

The patients' age, gender, history of anesthesia and surgery, and comorbid factors were questioned before EVAR and TEVAR procedures. Preoperative examinations were evaluated. The drugs they used were recorded. Preparations were made for blood and blood products. Consent documents were obtained for anesthesia. In elective cases, 5 mg peroral diazepam was administered as premedication on the night of the operation. All patients were intraoperatively monitored for cardiac statuses with electrocardiography in D2 and V5 derivations, oxygen saturation with pulse oximetry. Following intravenous cannulation with 16-18-gauge needles, appropriate crystalloid solution infusion was initiated. Arterial pressure monitorization was achieved by invasive right and left radial artery catheterization in patients with thoracic aortic pathologies and right radial artery catheterization in those with abdominal aortic pathologies. After evaluating the general condition of the patient according to the risk factors, the type of anesthesia was decided. General anesthesia was preferred in patients who may have problems obeying commands, experience severe pain or when there was a possibility of prolongation of the procedure, while local anesthesia with regional or sedoanalgesia was preferred for others. Induction of general anesthesia was achieved with 1-2 μ / kg fentanyl (Talinat, Vem Pharmaceutical Co., Turkey), 2mg / kg propofol (propofol Fresenius vial, Germany) and 0.6 mg / kg rocuronium (Myokro, Vem Pharmaceutical Co., Turkey). The patients were put on anesthesia device (Drager Primus, Germany) support following orotracheal intubation.The parameters of the anesthesia device were as follows: Fresh gas input: 2 L/min, FiO2: 50% (oxygen and air), Tidal volume: 8-10 ml/kg. Respiratory rate was regulated (partial carbon dioxide pressure was aimed to be 35-42 mmHg). Anesthesia was maintained by sevoflurane (Sevorane, Abbott, USA) inhalation. Central venous catheterization of the internal jugular vein was performed by the Seldinger technique to monitor central venous pressure when needed, according to the risk level of aortic pathology. A bladder catheter was placed for diuresis monitoring.

The same invasive procedures and monitorization were performed in patients in which local anesthesia or regional anesthesia with sedoanalgesia was planned. The targeted level of sedoanalgesia was coincided with a Ramsey sedation score of 3-4. 0.03 mg/kg midazolam (Zolamid, VemPharmaceutical Co., Turkey) and1μ/kg fentanyl (Talinat, Vem Pharmaceutical Co., Turkey) were administered at intermittent boluses. Systemic heparinization during endovascular repair was administered after one hour in patients undergoing regional anesthesia. Anticoagulation was monitored with activated coagulation time (ACT) measurement. Blood products were used according to hemoglobin and hematocrit values and blood loss.

Hemodynamic parameters of the patients were monitored, and vasopressor or antihypertensive agents were administered as needed. Patients were transferred to the intensive care unit following the endovascular repair procedure.

Statistical Method

SPSS 21.0 (Statistic Inc. version Chicago, IL, USA) software was used for statistical analysis of the data. Descriptive statistics were expressed as mean ± standard deviation for continuous variables and number of patients (%) for nominal variables. Results were considered statistically significant at p<0.05 at a confidence interval of 95%.

Results

Among 52 patients whose data were obtained from the hospital registry and patient files, 40 patients underwent EVAR for abdominal aortic pathology and 12 patients underwent TEVAR for thoracic aortic pathology. Fifteen patients were female, and 37 patients were male. There was a statistically significant male gender dominance in both groups (p <0.05). The mean ages of patients who underwent EVAR and TEVAR were 71.6 ± 7.26 years and 59.75 ± 15.29 years, respectively (p <0.05). The demographic data and preoperative characteristics of our patients are summarized in Table 1.

Table 1. The demographic and preoperative characteristics of patients

	EVAR (n=40)	TEVAR (n=12)	p
	n, %	**n, %**	
Female	11, % 27,5	4, % 33,33	
Male	29, % 72,5	8, % 66,67	
Aneurysm	31, % 77,5	9, % 75	
Aneurysm rupture	6, % 15	2, % 16,67	> 0,05
Dissection	3, % 7,5	1, % 8,33	
ASA 3	31, % 77,5	9, % 75	
ASA 4	9, % 22,5	3, % 25	
Mean age (Years) ± SD	71,6±7,26	59,75±15,29	< 0,05
Body weight (kg) ± SD	79,77±9,77	84,16±9,56	> 0,05
Ejection Fraction± SD	48,87±6,75	51,50±6,50	

SD: Standard deviation, p< 0,05: Significant, n: number, ASA: American Society of Anesthesiologists

The most frequent comorbidity in both the EVAR and TEVAR groups was hypertension (Table 2). Other comorbidities included diabetes mellitus, chronic obstructive pulmonary disease (COPD), cerebrovascular events, coronary artery disease, peripheral arterial disease, and smoking. There was no statistically significant difference in terms of comorbidities between the two groups (p> 0,05) (Table 2).

Seven out of 40 EVAR and three out of 12 patients TEVAR procedures occurred under emergency conditions. A patient who underwent emergency TEVAR procedure had trauma-related dissection in the etiology.

In our series of 42 patients, the most preferred anesthesia method was sedoanalgesia along with local anesthesia (n=30, 71.43%). Spinal anesthesia was preferred in all patients receiving regional anesthesia. Among EVAR patients, 8 underwent general anesthesia (20%), 11 underwent spinal anesthesia (27.5%) and 21 received local anesthesia with sedoanalgesia (52.5%). Among TEVAR patients, 3 underwent general anesthesia (25%) and 21 received local anesthesia with sedoanalgesia (75%). No statistically significant difference was found between the EVAR and TEVAR groups in terms of hemodynamic findings, duration of anesthesia, duration of surgery, intensive care unit and hospital stays (p> 0.05) (Table 3).

Table 2. The comorbidities of patients

	EVAR (n=40)	TEVAR (n=12)
	n , %	**n , %**
Hypertension	35,% 87,5	9, % 75
Diabetes Mellitus	7, % 17,5	2, % 16,67
COPD	12, % 30	4, % 33,33
Cerebrovascular events	3, % 7,5	1, % 8,33
Coronary Artery Disease	18, % 45	5, % 41,67
Peripheral Arterial Disease	11, % 27,5	3, % 25
Smoking	17, % 42,5	5, % 41,67

n: Number , COPD: Chronic Obstructive Pulmonary Disease

In the EVAR group, open surgery was performed after bleeding in three patients, neurological dysfunction, infection and endoleak development were seen in two, one and one patients, respectively. Among TEVAR patients, conversion to open surgery after bleeding was seen in one patient while one patient had endoleak development. Mortality was encountered in two of the EVAR and one of the TEVAR patients, with an overall mortality rate being 7.14%.

Table 3. Intraoperative and Postoperative Data

	EVAR (n=40)	TEVAR (n=12)
Preoperative Pulse (beats/min) ± SD	69,65 ± 11,09	71,42 ± 12,16
Intraoperative Pulse (beats/min) ± SD	68,45 ± 11,45	66,58 ± 9,39
Postoperative Pulse (beats/min) ± SD	69,73 ± 10,40	71,08 ± 10,66
Preoperative Mean Arterial Pressure (mm/Hg) ± SD	99,02 ±15,12	99,92 ± 14,56
Intraoperative Mean Arterial Pressure (mm/Hg) ± SD	77,30 ± 10,47	74,25 ± 10,54
Postoperative Mean Arterial Pressure (mm/Hg) ± SD	77,62 ± 11,03	79,58 ± 9,44
Duration of Anesthesia (minutes) ± SD	128,67 ± 14,65	126,75 ± 10,67
Duration of Operation (minutes) ± SD	107,97 ± 13,64	104,16 ± 10,31
Intensive Care Unit Stay (days) ± SD	1,62 ± 0,76	1,89 ± 0,78
Duration of Hospitalization (days) ± SD	4,72 ± 1,52	5,25 ± 1,74
SD: Standard Deviation, n: Number		

Discussion

The concept of endovascular aortic reconstruction, first proposed by Volodos et al. and then by Parodi et al. in 1991, is now accepted as a reliable method [6-8]. This has changed the treatment approach of aortic pathologies and rendered endovascular repair the preferred treatment model. Endovascular repair has become feasible in all aortic pathologies with the development of hybrid techniques and new generation stent grafts.

There are studies showing that endovascular approach in aortic repair significantly reduces perioperative mortality and morbidity compared to open surgery [9-15]. Advantages of endo-

vascular technique include the lack of laparotomy, thoracotomy, and the need for clamping the aorta, therefore less blood loss [9-15]. In addition, in endovascular repair, physiological stress of the patient is less than open surgery. Therefore, endovascular techniques have become prominent in the treatment of aortic pathology in patients with severe comorbid diseases who are not suitable for open surgery.

Advanced age, family history, male gender, cardiovascular disease, and smoking are among the identified risk factors for abdominal aortic aneurysms [16-18]. In a study about the effect of gender on the rate of enlargement of abdominal aortic aneurysms, Mofidi et al. reported that the incidence of abdominal aortic aneurysm is four times higher in men than in women [19]. In our study, 29 patients (72.5%) were male and 11 patients were female (27.5%) in our EVAR series, and the mean age in this group was 71.6 ± 7.26 years (Table 1). In addition, it was found that coronary artery disease and smoking accompanied 47.5% and 45% of the patients, respectively (Table 2). All these results were consistent with the literature. The mean age of our TEVAR patients was significantly lower than that of EVAR patients ($p < 0.05$) (Table 1), which was compatible with the study by Piffaretti et al. [20].

Hypertension is one of the most crucial factors in the etiopathogenesis of aortic aneurysms [21]. Hypertension is reported to accompany aortic dissection in 75% of patients. In our patients, hypertension was concurrent in 87.5% of patients treated with EVAR and 75% treated with TEVAR, which showed that hypertension was an important etiologic factor in our series (Table 2).

In their abdominal aortic aneurysm patient series in which they performed open and endovascular repair, Menezes FH et al. reported that the rate of comorbidity of diabetes mellitus was 12.09 % [22]. In our study, this rate was 17.5% in EVAR and 16.67% in TEVAR patients. Although our results were slightly higher, we concluded that akin to the literature, diabetes mellitus was an important comorbid factor.

These comorbidities increase the risk of anesthesia in aortic pathologies, which is highly hazardous itself. The availability of regional and local anesthesia methods makes endovascular intervention advantageous in high-risk patients [23]. With the increase in the number of endovascular repair therapies, studies on anesthesia experience and comparison of anesthetic methods have started to take place in the literature [5,24,25]. In these studies, it was emphasized that patient compliance and urgency, location of aortic pathology, anesthesiologist's experience and duration of operation were crucial factors in choosing an anesthesia method during endovascular aortic procedures.

In patients undergoing endovascular aneurysm repair, general, epidural and local anesthesia methods have been compared and local anesthesia has been reported to provide better hemodynamic stability [25,26]. In our study, the most preferred anesthesia method was local anesthesia with sedoanalgesia with a rate of 71.43% among all our patients.

Sedoanalgesia can be administered as infusion and intermittent bolus [27]. We administered a combination of midazolam and fentanyl as intermittent bolus according to Ramsey sedation scale in our patients and encountered no complications.

It has been reported that regional anesthesia techniques can be applied successfully in endovascular graft treatments and that conversion to general anesthesia is low [24,28]. However, it is stated that anticoagulants used in patients after the procedure and patients with coagulation disorders will expose patients to complications such as spinal hematoma [29]. Huang et al. reported that spinal anesthesia may be a better choice instead of anesthesia administered through an epidural catheter [29].

We found that spinal anesthesia was the preferred method of regional anesthesia in our patients with a rate of 100%. In order to prevent the risk of spinal hematoma complication, we waited for one hour after regional intervention for systemic heparinization, as recommended by ASA [30].

General anesthesia may be preferred especially in emergency cases where the hemodynamics are disrupted, in procedures that may last for a long time depending on the location of the aortic pathology, in cases requiring controlled respiration and in patients who can not maintain the necessary immobility during the procedure. However, studies of large series conclude that general anesthesia may increase mortality morbidity rates, and prolong intensive care and hospital stays in these patients [5, 24-26]. Another study with broad participation associated general anesthesia with prolonged operation time and high systemic complications in addition to prolonged intensive care stays and duration of hospitalization in EVAR patients [28].

In our study, the rate of general anesthesia was 20% in EVAR and 25% in TEVAR patients. While urgent and hemodynamically unstable cases constitute some of these patients, the long duration of operation and inadequate cooperation of the patient have been effective in the preference of general anesthesia, similar to the literature. We believe that preferring general anesthesia in hemodynamically unstable patients may be associated with increased mortality and morbidity, as well as prolonged intensive care and hospital stay.

Dutch Randomized Endovascular Aneurysm Management (DREAM) study comparing the short-term results of endovascular treatment with open surgical treatment is one of the most important studies in this field (345 cases, 171 endovascular repairs, 174 open surgical repairs) [9]. In this study, operative time was 135 (105-150) minutes, intensive care unit stay was 16 (0-20) hours, hospital stay was 6 (3-6) days in endovascular repair, and these results were reported to be significantly shorter than open surgery. Menezes FH conducted a similar study et al. on 377 patients (286 open surgical repairs, 91 endovascular repairs) [22] and found that operation time was 3.58 ± 1.26 hours, and hospital stay was 9.37 ± 10.65 days in endovascular repair.These results were reported to be significantly shorter than open surgery as well. In our study, the duration of surgery and hospitalization in our EVAR and TEVAR patients were shorter than the other studies and similar to DREAM results (Table 3). The duration of ICU stay was 1.62 ± 0.76 days in EVAR patients and 1.89 ± 0.78 days in patients who underwent TEVAR (Table 3), and these periods were longer than, although close to, DREAM results.

In the DREAM study which compares the results of open surgery and EVAR, researchers found that mortality rates were 1.2% in the EVAR group.In the study of Menezes et al., the same rate was reportedly 7.69% in EVAR patients [9,22]. In our study, the mortality rate was 7.14% among all patients undergoing endo-

vascular procedure. This result is higher than the DREAM study and close to that of Menezes et al. While bleeding was the most common complication among all our patients, neurological dysfunction, superficial wound infection and endoleak development were also encountered. Bleeding and other complications were found to be higher than the DREAM study. We believe that surgical experience as well as the number of patients are important factors in differing results among various centers.

Cost is one of the essential elements that the researches on this subject emphasize. Jon S. Matsumura et al. compared the costs of open surgical treatment and endovascular treatment in a randomized study of 881 patients with abdominal aortic aneurysms. They found that although the cost in endovascular treatment was lower than open surgery, this difference was not statistically significant [31].

The limitation of our study was the small number of patients and its retrospective nature.

Conclusion:

Less invasive and faster procedures, shorter hospital stay, increased patient comfort, and high success rates are all factors contributing to the wide acceptance and spread of endovascular techniques in aortic pathology. These patients are also high-risk bearers for anesthesia. The selection of the appropriate anesthesia method should be based on the evaluation of the individual characteristics for each patient. Surgical factors, patient compliance, and comorbidities are principal factors in this selection. We believe that the endovascular procedure outcomes are more dependent on the characteristics of the patient than the anesthetic method.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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References

1. Sampson UK, Norman PE, Fowkes FG, Aboyans V, Yanna S, Harrell FE, et al. Global and regional burden of aortic dissection and aneurysms: mortality trends in 21 world regions, 1990 to 2010. Global heart. 2014;9(1):171-80.

2. Akin I, Kische S, Rehders TC, Ince H, Nienaber CA. Thoracic endovascular stent-graft therapy in aortic dissection. Curr Opin Cardiol. 2010;25:552-9.

3. Baril DT, Cho JS, Chaer RA, Makaroun MS. Thoracic aortic aneurysms and dissections: endovascular treatment. Mt Sinai J Med.2010;77(3):256-69.

4. Hastaoğlu İO, Toköz H, Bilginer N. Endovasküler stent greft orta dönem sonuçlarımız: Yüksek riskli hastalarda istenilen mortalitenin neresindeyiz? (Endovascular stent graft mid-term results: Where are we at desired mortality in high-risk patients?)Turk Gogus Kalp Dama./ Turkish Journal of Thoracic and Cardiovascular Surgery. 2014;22(3):558-63.

5. Edwards MS, Andrews JS, Edwards AF, Ghanami RJ, Corriere MA, Goodney PP, et al. Results of en¬dovascular aortic aneurysm repair with general, regional, and local/ monitored anesthesia care in the American Col¬lege of Surgeons National Surgical Quality Improvement Program database. J Vasc Surg. 2011; 54(5):1273–82.

6. Volodos NL, Shekhanin VE, Karpovich IP, Troian VI, Gur'ev IA. A self-fixing synthetic blood vessel endoprosthesis. Vestn Khir Im II Grek. 1986;137:123-5.

7. Volodos NL. Historical perspective: the first steps in endovascular aortic repair: how it all began. J Endovasc Ther. 2013;20(Suppl. 1):S13–123.

8. Parodi JC, Palmaz JC, Barone HD. Transfemoral intraluminal graft implantation for abdominal aortic aneurysms. Ann Vasc Surg. 1991;5(6):491–9.

9. Prinssen M, Verhoeven EL, Buth J, Cuypers PW, van Sambeek MR, Dutch Randomized Endovascular Aneurysm Management (DREAM) Trial Group, et al. A randomized trial comparing conventional and endovascular repair of abdominal aortic aneurysms. N Engl J Med. 2004; 351(16):1607-18.

10. Greenhalgh RM, Brown LC, Kwong GP, Powell JT, Thompson SG; EVAR trial participants. Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30-day mortality results: randomised control trial. Lancet. 2004; 364:843-8.

11. Schermerhorn ML, O'Malley AJ, Jhaveri A, Cotterill P, Pomposelli F, Landon BE. Endovascular vs open repair of abdominal aortic aneurysm in the Medicare population. N Engl J Med. 2008; 358(5):464-74.

12. Makaroun MS, Dillavou ED, Wheatley GH, Cambria RP. Five-year results of endovascular treatment with the Gore TAG device compared with open repair of thoracic aortic aneurysms. J Vasc Surg. 2008; 47:912-18.

13. Matsumura JS, Cambria RP, Dake MD. International controlled clinical trial of thoracic endovascular aneurysm repair with the Zenith TX2 endovascular graft: 1 year results. J Vasc Surg. 2008; 47:247- 57.

14. Bavaria JE, Appoo JJ, Makaroun MS. Endovascular stent grafting versus open surgical repair of descending thoracic aortic aneurysms in low-risk patients: a multicenter comparative trial. J Thorac Cardiovasc Surg. 2007; 133:369-77.

15. Fairman RM, Criado F, Farber M, Kwolek C, Mehta M, White R, et al. Pivotal results of the Medtronic Vascular Talent Thoracic Stent Graft System: the VALOR Trial. J Vasc Surg. 2008; 48(3):546-54.

16. Cornuz J, Sidoti Pinto C, Tevaearai H, Egger M. Risk factors for asymptomatic abdominal aortic aneurysm: systematic review and meta-analysis of population-based screening studies. Eur JPublic Health. 2004; 14(4):343-9.

17. Lederle FA, Johnson GR, Wilson SE, Chute EP, Hye RJ, Makaroun MS, et al. The aneurysm detection and management study screening program: validation cohort and final results. Aneurysm Detection and Management Veterans Affairs Cooperative Study Investigators. ArchIntern Med. 2000; 22:160(10):1425-30.

18. Powell JT, Greenhalgh RM. Clinical practice. Small abdominal aortic aneurysms. N Engl J Med. 2003;8:348 (19):1895-1901.

19. Mofidi R, Goldie VJ, Kelman J, Dawson AR, Murie JA, Chalmers RT. Influence of sex on expansion rate of abdominal aortic aneurysms. Br J Surg. 2007; 94(3):310-14.

20. Piffaretti G, Tozzi M, Lomazzi C, Rivolta N, Caronno R, Castelli P. Complications af¬ter endovascular stent-grafting of thoracic aortic diseases. J Cardiothorac Surg. 2006;1:26.

21. Braverman AC. Acute aortic dissection: clinician update. Circulation. 2010;122(2): 184-8.

22. Menezes FH, Ferrarezi B, Souza MA, Cosme SL, Molinari GJ. Results of Open and Endovascular Abdominal Aortic Aneurysm Repair According to the E-PASS Score. Braz J Cardiovasc Surg. 2016;31(1):22-30.

23. Ruppert V, Leurs LJ, Rieger J, Steckmeier B, Buth J, Umscheid T. Risk-adapted outcome after endovascular aortic aneurysm repair: analysis of anesthesia types based on EUROSTAR data. J Endovasc Ther. 2007; 14(1):12-22.

24. Wax DB, Garcia C, Campbell N, Marin ML, Neustein S. Anesthetic experience with endovascular aortic aneurysm repair. Vasc Endovascular Surg. 2010;44(4):279-81.

25. Bettex DA, Lachat M, Pfammatter T, Schmidlin D, Turina MI, Schmid ER. To compare general, epidural and local anaesthesia for endovascular aneurysm repair (EVAR). Eur J Vasc Endovasc Surg. 2001; 21:179-84.

26. De Virgilio C, Romero L, Donayre C, Meek K, Lewis RJ, Lippmann M, et al. Endovascular abdominal aortic aneurysm repair with general versus local anesthesia: a comparison of cardiopulmonary morbidity and mortality rates. J Vasc Surg. 2002; 36:988-91.

27. Güzel A, Doğan E, Karaman H, Aycan İÖ, Çelik F, Çiftçi T, et al. Aort patolojilerinin endovaskuler tedavisinde anestezi yönetimi (Anesthesia management in endovascular treatment of aortic pathologies). Dicle Tıp Dergisi/ Dicle Medical Journal. 2014; 41 (2): 357-63.

28. Ruppert V, Leurs LJ, Steckmeier B, Buth J, Umscheid T. Influence of anes¬thesia type on outcome after endovascular aortic aneurysm repair: an analysis based on EUROSTAR data. J Vasc Surg. 2006; 44(1):16-21.

29. Huang JJ. Spinal anesthesia for endoluminal abdominal aor¬tic aneurysm repair. J Clin Anesth. 2002; 14:176-8.

30. Horlocker TT, Birnbach DJ, Connis RT, Nickinovich DG, Palmer CM, Pollock JE, et al. Practice advisory for the prevention, diagnosis, and management of infectious complications associated with neuraxial techniques: a report by the American Society of Anesthesiologists Task Force on infectious complications associated with neuraxial techniques. Anesthesiology. 2010; 112: 530-45.

31. Matsumura JS, Stroupe KT, Lederle FA, Kyriakides TC, Ge L, Freischlag JA. Open Versus Endovascular Repair (OVER) Veterans Affairs Cooperative Study Group. J Vasc Surg. 2015; 61 (1): 59-65.

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